POLAR BEAR DENNING SURVEYS IN THE KITIKMEOT REGION, 1977-86

Northwest Territories Resources, Wildlife & Economic Development

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POLAR BEAR DENNING SURVEYS IN THE KITIKMEOT REGION, 1977-86

ANNE GUNN

GOO ARLOOKTOO

JOE ASHEVAK

LLOYD JONES

AND

DAVID KAOMAYOK

DEPARTMENT OF RENEWABLE RESOURCES

GOVERNMENT OF THE NORTHWEST TERRITORIES

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Northwest Territories Renewable Resources

ABSTRACT

We surveyed for polar bear dens in areas identified by hunters as traditional denning areas. The surveys of Collinson Peninsula and Admirality Island in March-April 1984; Admirality and Taylor islands in April 1985; northern King William Island in April 1986 were relatively unsuccessful as measured by the paucity of dens found. The virtual absence of dens is likely the result of poor denning conditions as shallow snow and strong winds characterized the fall weather and adequate snowdrifts did not accumulate early enough for denning. The snowfall in the Pelly Bay area was adequate in the fall of 1985. The 23 bear dens on a mainland peninsula in the vicinity of the Harrison Islands is one of the highest density of dens described in the Canadian Arctic. The denning surveys also suggest that the use of temporary (non-maternal dens) may be more frequent than described in the literature. The surveys assist in scheduling human activities to avoid polar bear denning areas. The survey results also suggest that fall weather (snowfall and wind direction) are important factors that influence the annual use of traditional denning areas.

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INTRODUCTION

Surveys to locate and describe the winter dens of polar bears (Ursus maritimus) have been undertaken in the Kitikmeot Region since 1977. Initially, the objective of the surveys was to locate important denning areas for polar bears. The importance of knowing the location of bear dens lies in the use of dens by pregnant bears to give birth in and to raise the cubs (maternity dens). Other bears use temporary dens during severe weather (Harington 1968). Bears about to den, and actually inside their dens, are sensitive to human activities and may abandon them (Harington 1968, Ramsay and Stirling 1986). Information on the location of denning areas can be used as the basis to avoid conflict between human activities and denning bears.

The locations of many denning areas and the general time of emergence from the dens have been reported (e.g., Harington 1968, Freeman 1976, Kiliaan et al. 1978, Stirling et al. 1981, Schweinsburg et al. 1981); however, little is known about annual variation in the use of denning areas, the use of the denning areas by bears of different sex and age classes or the timing and behaviour of bears as they dig and enter their dens.

Inuit hunters tend to be well acquainted with where polar bears den. In the past, bears were taken while in dens and denning areas were regarded as "food reserves" being an almost certain source of meat if caribou or seal hunting was poor. This clearly implies a predictability in the location of dens -- the result of

suitable environmental features and traditional behaviour. Additionally, denning areas are also where bears will be found after emergence from their dens and, thus, those denning areas are still important hunting areas.

The polar bear denning surveys depend on the local knowledge and involvement of hunters. In the Kitikmeot Region, hunters have identified northern King William Island, Taylor and Admiralty islands off the southeast coast of Victoria Island, the Royal Geographical Society Islands and the Harrison Islands (Freeman 1976, Hunters' and Trappers' Associations meetings). The objective of surveys in 1984, 1985 and 1986 was to verify the current use of those areas for denning by polar bears. The repetition of the surveys of denning on Gateshead Island, off the eastern coast of Victoria Island, was to describe annual variation in the numbers of dens. Gateshead Island is known for its relatively high concentration of polar bear dens (Schweinsburg et al. 1984).

In this report, we present the results of the denning surveys in 1984, 1985 and 1986. We have also compiled the results of the previous denning surveys in the Kitikmeot Region (Table 1) as not all of those results are readily available. We discuss the results of those surveys with respect to polar bear biology and management.

Table 1. Summary of polar bear denning surveys in the Kitikmeot Region, NWT, 1977 - 1986.

Year/Month	Area	Dens	Reference
1977			
7-20 April	Gateshead Island	18	Spencer/Schweinsburg 1979
1982			
5-14 April	Gateshead Island	15	Williams & Jingfors 1983
5-17 April	east coast, Boothia Pen.	0	Helmer (pers. comm.)
1983			
31 March - 11 April	west coast, Boothia Pen.	4	Bailey & Ashevak 1984
1-22 April	Storkerson Pen.	3	Jingfors & Kaomayok 1984
1984			
30 March - 6 April	Wales Island	2	J. Ashevak (pers. files)
31 March - 7 April	Collinson Pen.	4	This report
2-10 April	Prince of Wales St.	0	Jingfors & Adjun 1984
1985			
2-10 April	Admiralty Isl.	4	This report
3-11 April	north King William Isl.	2	This report
1986			
24 March - 4 April	Harrison Islands	24	This report
26 March - 6 April	Gateshead Island	4	This report

METHODS

The observers travelled by snowmachine to the survey area where they searched for polar bears, their tracks and dens. Beach ridges, river valleys and other topographic features that would accumulate snowbanks were scrutinized either at a distance with binoculars or by travelling along the slope for snow mounds marking the entrance of dens ("porches", Harington 1968). The observers also looked for signs of arctic fox (Alopex lagopus) or polar bear diggings on the slopes.

When a site of a den or digging was located, we probed the surrounding area before digging into a den unless it was filled with snow. The snow conditions, den dimensions and slope aspect and steepness were recorded. The den, bear sightings and bear tracks were located on 1:250,000 topographical maps. The hunters assigned any bear tracks found to sex and age classes of the bear based on the size and spacing of the tracks.

Daily distance travelled was taken from the snowmachine odometer or the topographical map. The observers also noted daily weather, snow and ice conditions and wildlife sightings.

We returned to Gateshead Island on 8 July 1986 by helicopter. We flew along the snowbanks looking for collapsed dens and any other signs of bear activity.

RESULTS

1. Collinson Peninsula and Admiralty Island, April 1984

The three observers (D. Amigainik, L. Jones and D. Kaomayok) travelled 710 km between 31 March and 7 April, 1984 and located four polar bear dens on Collinson Peninsula on 4 April. The four were temporary dens and were between 5 and 7 km inland in a low-lying, lake studded area. The first den (84-1) was dug into the 3-4 m deep snow on a southeast facing slope of a low hill (43 m asl). The abandoned den was lightly iced and was 1.8 m high inside. The tracks around the den were of an adult female with two 2-year-old cubs.

The other three polar bear dens were all on the southeast facing slope of a small hill (30 m asl) 3 km north of the first den. The den with the largest porch (84-2) was on a southeast facing slope and about 6 m from the top of the hill. The den had urine stains outside and was filled with snow. The tracks were of a female with her 2-year-old offspring.

Fall tracks were visible in the hard packed fall snow and more recent tracks were visible on top of the fall snow where the storm of 31 March had blown the earlier snow away. The third den (84-3) was only 4 m northeast of 84-2 and 10 m further up on top of the hill. A bear had dug and laid in a temporary bed and left two scats.

One set of bear tracks was found about 10 km northwest of the dens where a bear, possibly a 4-year-old female, had slept on the

north side of a small hill before travelling to Larsen Sound. Another set of tracks, probably another 4-year-old bear, was found on the hard-packed fall snow on a small island, off the northwest coast of Cape Admiral Collinson.

The terrain north of the four bear dens was too flat for the accumulation of snowdrifts suitable for denning. The eskers that ran in a northwesterly direction were also too low (20 m) for the accumulation of sufficient snow. The snow conditions had been influenced by the ice storms in early winter. Subsequently, drifting snow blew over the ice-covered ground and the relatively gentle terrain of Collinson Peninsula and did not build up into drifts probably until December. A severe storm on 31 March had redistributed the more recent snow exposing the surface of the hard-packed snow from early in the winter.

Visibility was poor in the drifting snow (Appendix A) on 6 April when the observers travelled on the west side of Admiralty Island and found no dens. The absence of dens may reflect the shallowness of snow drifts early in winter. We found no bear tracks on Admiralty Island or on the sea ice between the island and Collinson Peninsula. The sea ice was rough first-year ice except for a couple of pieces of second-year ice between Admiralty Island and Collinson Peninsula.

2. Admiralty and Taylor Islands, April 1985

The five observers (G. Arlooktoo, A. Gunn, D. Kaomayok, J. Lyall and W. Nakashook) travelled 900 km between 2 and 10 April

1985. Within a few kilometres of Nordenskiold Islands upended floes of multi-year ice blocked our passage and prevented us from reaching the Royal Geographical Society Islands. We returned to Jenny Lind Island and travelled north where we found three dens on Taylor Island and one den on Admiralty Island, but none appeared to be a maternity den based on size and tracks.

The first den was dug into a southeast-facing slope (c. 30 degrees) on a small island lying off the south end of Taylor Island (7 April). The small den was just below the top of a slope only about 10 m high. The den was lightly iced: close-by was a shallow pit (c. 8 cm deep) and two dark loose scats typical of a bear feeding on seals. Another scat 100 m away on the top of the ridge contained vegetation which suggested a den in the vicinity but buried by a severe storm at the end of March.

Two other dens were found on a southeast facing slope along the east coast of Taylor Island on 9 April, 1985. One den had partially collapsed and filled with snow. The den was at the top of the ridge (slope c. 35 degrees): the den may have had two chambers but the fresh snow hampered reconstruction of the internal architecture. The maximum width was 150 cm and there were scattered willow (salix spp.) leaves and traces of urine on the floor, which was moderately iced. The second den was 250 m south of 85-3 and was dug into a relatively steep slope 5 m from the crest of the ridge. The maximum width of the single chamber was 170 cm. The inside was heavily iced and clawed and the floor had slight traces of urine and a few scattered willow leaves.

The den on Admiralty Island was in a snowbank along a southeast facing beach ridge on the east coast. The den was found on 8 April by probing a 1.5 m deep hole dug by an arctic fox. The den's chamber was buried by about 2 m of fresh snow. The chamber was 120 x 160 cm; the walls were heavily iced and there were willow leaves and urine traces on the floor.

Polar bear tracks were only seen in the vicinity of the first den on Taylor Island. The tracks of an adult female with two 2- or 3-year old cubs slid down the upper part of the slope by the den and headed toward the sea ice. The tracks of a young bear, possibly a male, followed the other tracks along the ridge before turning away to the west. No tracks were seen on or around Taylor or Admiralty islands apart from a few old, almost obliterated tracks from the fall.

The snowbanks along the beach ridges were deep, but it was mostly fresh snow from storms in March. The sea ice between the southeast coast of Victoria Island to Jenny Lind Island was flat ice interspersed with pressure ridges. The bear tracks along the 2 m high pressure ridge between Jenny Lind and Taylor islands were relatively fresh and from subadult and adult bears. A large adult male bear had dug into a ringed seal (Phoca hispida) birth lair (170 x 93 cm). There were bloody afterbirth fluids, but no evidence of a kill. Polar bear tracks were not found on the chaotically rough first-year ice east of Jenny Lind Island although arctic fox tracks were numerous.

3. Northern King William Island, April 1985

The three observers (S. Aaluk, L. Jones and J. Ashevak) travelled 1032 km between 3 and 11 April, 1985 and located two polar bear dens on the northwestern coast of King William Island on 8 April. The two dens were about 3 km inland in a low-lying area studded with lakes and beach ridges. The first den was dug into the 1.75 m deep snow on a gentle, south facing slope of a hill (68 m asl). The abandoned den was heavily iced and was 0.9 m high inside: the width and length to the porch were 1.5 x 4.2 m. There were no tracks around the den, but the size of the den suggested that a subadult bear had used it. The second den was about 33 m from the first den and was a double-chambered den also on a gentle south-facing slope. Both chambers were 0.5 m high but one chamber (1.8 x 2.8 m) was larger than the other (1.3 x 2.4 m) and was set further back from the porch. Between the two dens were polar bear urine and scats and about 28 m away from the second den was a dugout. Again, the wind had obliterated the tracks but probably a female and her yearling cub had denned there.

The observers travelled to Matty Island and checked the beach ridges: along the southeast coast there was too little snow but there was more snow on the central east hill - a traditional denning area (S. Aaluk pers. comm.). On the Tennent Islands there were three sites within 10-15 m of each other where a bear had started digging a den but there had not been enough snow. The diggings had been found by B. Konana in December 1984 and there were no tracks left. On the islands was 1-3 cm of groundfast ice

from fall storms and fresh snow from a storm on 25 March 1985 had covered the hard snow from earlier in the winter.

The observers travelled west across the northern tip of King William Island and checked three areas of traditional denning in the northeast but did not find signs of bears. At two areas of traditional denning on the northeast coast, however, bears had attempted to den. On the south slope of a hill (68 m asl), 8 km inland, a bear had started a den but had given up in the shallow snow. On the south slope of a hill 1 km inland from Cape Jane Franklin a bear had also attempted to den but had abandoned the effort.

The only bear tracks that the observers found were those of a young male bear. The tracks were only a few hours old and were on Collinson Inlet, western King William Island. More tracks were seen during a hunting trip up the west coast on 8 and 9 April (L. Kamoolak pers. comm.). The 21 sets of tracks included one large male bear but apparently no females with cubs.

4. Harrison Islands, March-April 1986

The observers from Pelly Bay (Charlie Niptayok and Inigo Kukkuyak) and from Spence Bay (Joe Ashevak) travelled 670 km. They searched traditional denning areas on the islands scattered around Kull Island (69° 33'N., 90° 19'W.) and the hills on a mainland peninsula (69° 30'N., 90° 30'W.) north of the Harrison Islands. Only one den (86-1) was found on the islands, but 23 dens were concentrated on the peninsula (77 km^2). Four of the 24 dens (Table 2)

Table 2. Details of polar bear dens found 24 March to 4 April 1986, in the Harrison Islands, Pelly Bay, NWT.

Date	No.	Slope	Aspect	Icing (cm)	Type	Comments
26/03	1	mod.	S	5	temp.	tracks - female
30/03	2	mod.	S	-	temp.	female/2 cubs inside
	3	mod.	S	<3	temp.	20 m from #2, tracks
	4	mod.	S	<3	temp.	old tracks - cubs
	5	mod.	S	<3	temp.	5 m from #4, old tracks
	6	mod.	SE	<3	temp.	tracks - young bear
	7	mod.	SE	<3	temp.	tracks - young bear
31/03	8	steep	E	<3	temp.	female/cubs
	9	steep	E	<3	temp.	50 m from #8
	10	steep	E	<3	temp.	tracks - female/cubs
	11	mod.	S	<3	temp.	tracks - female/cubs
	12	mod.	S	>5	birth	abandoned
	13	steep	S	>5	winter	tracks - younger bear
31/03	14	mod.	S	>5	birth	long abandoned
	15	mod.	SE	>5	winter	old tracks - female
	16	mod.	E	>5	winter	tracks - large male
	17	mod.	E	<3	temp.	tracks - cubs
	18	mod.	E	<3	temp.	100m from #17, tracks
	19	mod.	SE	>5	birth	tracks - cubs
	20	mod.	E	-	-	female bear inside
01/04	21	mod.	SW	>5	birth	tracks - cubs
	22	mod.	SW	>5	winter	no tracks - hard snow
	23	mod.	S	<3	temp.	tracks 150 m from 21
	24	mod.	S	<3	temp.	tracks - cubs

were maternity dens. Eleven were dens dug by a female bear with cubs of the year after she had emerged from her maternity den: one of those dens was still occupied by a female and two cubs. Nine other dens were those of single bears which were one large male, three females without cubs (one was still in her den) and the remainder were those of younger bears. Twenty dens were on slopes categorized as of moderate steepness and four dens were on steep slopes. Half the dens were on slopes facing south, four dens were on slopes facing southeast, seven dens were on slopes with an eastern aspect and one den was on a slope facing southwest.

The four maternity dens were characterized by being large with long tunnels and dirty. Den SB86-12 was between 10.6 and 12.2 m long; den SB86-14 was c. 12 m long; den SB86-19 was 4.5 x 1.5 x 0.9 m; and den SB86-21 was Y-shaped and 6 m from the labour area in one "arm" and the tunnel entrance in the second "arm".

The temporary dens dug by females with newborn cubs after they had emerged from the maternity den were relatively small dens with icing less than 2 cm thick. Four pairs of the dens were close together: SB86-2 and -3 were 15 m apart, SB86-4 and -5 were 6 m apart, SB86-8 and -9 were 60 m apart and SB86-17 and -18 were 100 m apart. Possibly, the same female had dug both dens of a pair. Den SB86-21 was only 150 m from a maternity den.

Two of the dens used by single bears were temporary dens only lightly iced inside. The other five dens were more heavily iced with up to 12 cm of ice suggesting that they had been occupied for a longer period.

Two dens were still occupied: SB86-2 had a female and cubs in it on 30 March and SB86-20 had a female in it on 31 March. On 1 April a female with two small cubs was seen feeding on a young seal pup. No other bears were seen but there were bear tracks in the area heading toward the open water which was some 10 km away.

5. Gateshead Island, March-April 1986

The four observers (P. Avalik - replaced by J. Lyall after an accident on 27 March, A. Gunn, D. Kaomayok, and W. Nakashook) travelled 1400 km between 22 March and 4 April 1986. We found one den on Gateshead Island and two dens on a small island off the north coast of Gateshead Island. Snow banks were considerably shallower than in previous years so we checked inland hills on Collinson Peninsula but the same situation of shallow snow prevailed. We found one temporary den about 9 km inland.

The den on Gateshead Island was about 10 m from the crest of a south-facing gravel beach ridge (c. 25 degrees). The two-chambered den was 0.5 high and the width of each chamber was 1.2 m and 1.5 m. Inside the den were urine stains and icing c. 3 cm thick. Outside the den hair was stuck to the snow where the bear had rolled and the tracks were those of a medium-sized bear.

The second and third dens that we found were 300 m apart on a southwest facing beach ridge. One den was small and partially dug open and blown in. It was probably the den of a subadult bear. The third den (86-3) had a large porch outside which was the bear's anal plug (three scats composed mostly of mosses). The den's

internal architecture was obscured by blown-in snow, but was likely a maternity den as the tracks were those of a female and two cubs. About 10 m away from the den was a shallow pit dug by a bear. We only found one attempted den: a bear had dug a hole in a south-facing bank last fall.

A few kilometres southwest of Gateshead Island we saw a female and 2-year-old bear both of which looked rounded and fat (29 March). Their tracks were along a crack in the ice and the bears had broken open a bearded seal's (Erignathus barbatus) breathing hole. On a small island off the north coast of Gateshead Island two bears were sitting together on a beach. As we approached they ran to the nearby rough ice - one was an adult male and the other was a subadult.

The snow was too hard and there was also too little snow to tell if there were fewer fall tracks than in previous years. We found the more recent tracks of an adult female bear as well as two subadult bears travelling in the rough ice. A young male bear had travelled along one of the beach ridges on Gateshead Island. On the ice north of Gateshead Island we found the tracks of an adult male, two subadults and an adult male travelling with a subadult.

Most of the northwest slopes of the beach ridges on Gateshead Island were bare and the ridge tops were almost bare ground. South- and east-facing slopes had concave shaped, rather than convex shaped, snowbanks.

We flew along almost all of the conspicuous beach ridges on 8 July 1986 and found the dens that we had earlier located in March-

April 1986. The dens had collapsed and were readily recognizable in the remnant snowbanks. About 30 m west of a den located in March was a den connected by a tunnel to a double den 10 m away. Those three dens must have been covered by snow in March as we had not seen them. There were no scats or other signs of bear activity. We also found another den that we had not seen in March: the den had collapsed and was a small den with a single chamber. Summer dens - round pits dug into the gravel of beach ridges - were found on the smaller islands as well as Gateshead Island itself.

DISCUSSION

Two of the five denning surveys in the Kitikmeot Region reported here covered areas identified by hunters as traditional denning areas and which had not been previously surveyed. Hunters have identified the islands across the mouth of Pelly Bay and Simpson Peninsula as denning areas (Van de Velde 1957, 1971; Freeman 1976) and northern King William Island.

The finding of 23 dens concentrated in an area of only about 77 km^2 is a notably high density of dens for arctic Canada. For comparison, the 19 and 15 dens on Gateshead Island (266 km^2) in 1978 and 1982, led to the identification of Gateshead Island as an important denning area (Schweinsburg et al. 1984). The higher density of dens on the mainland in the vicinity of the Harrison Islands may result from the rugged hilly terrain and heavier snowfall (Maxwell 1980) increasing the number of snowbanks suitable for denning. The area is in the vicinity of Pelly Bay, known for its active ice and high seal densities (C. Niptayok pers. comm.).

The use of dens by adult males is known (Harington 1968) but is not considered common. Van de Velde (1957) noted the denning by females with cubs either 1 or 2 years old, but again is not considered common. Our results suggest that the use of temporary dens may be more frequent than expected. One of us (DK) suggests that the condition of the bears may play a role with thin bears being likely to den during severe cold or stormy weather.

The finding of only a few dens or attempted dens on northern King William Island, the second traditional denning not previously

surveyed did not contradict the area's identification as a traditional area. Further surveys under different snow and ice conditions will be necessary to evaluate the current status of northern King William Island as a denning area.

The success of denning surveys in the Kitikmeot Region as measured by numbers of dens found during each survey is sporadic. A total of 81 dens was found during the 12 surveys and 3 surveys contributed most (71%) of the sightings of dens. The lack of success of some surveys may reflect their timing relative to late winter weather, and annual variation in the distribution of the bear dens.

Storms during March and April can cover the signs left by bears emerging from their dens and there may be no visible traces of the dens. We likely missed finding recently snow-covered dens during the 1985 survey of Taylor and Admiralty islands, northern King William Island and the 1986 surveys of Gateshead Island and the Harrison Islands. Storms can also sweep more recent snow away from the hard surface of early winter snow which removes recent tracks but may reveal earlier tracks. Surveying earlier in March lessens the chances of storms obliterating traces of dens but some bears will be still in their dens (Table 3). Information is lost when the bear is still in its den (type of den and the sex-age class of the bear) besides the disturbance of the bear and risk to the observers. The use of dogs to sniff out dens would contribute to the practicality of surveying at the end of March when most

Table 3. Summary of dates of polar bear denning surveys, type of den and occupation of dens by bears, NWT.

Year	Day/Month	Temporary	Winter	Birth	Occupied
Kitikmeot Region (Bailey and Ashevak 1984, Jingfors and Adjun 1984, Jingfors and Kaomayok 1984, Spencer and Schweinsberg 1979, Williams and Jingfors 1983, this report)					
1977	07-20/04	6	0	3	1?
1982	05-14/04	2	3	10	3
1983	31/03-11/04	5	0	0	0
	01-22/04	2	0	1	0
1984	30/03-06/04	2	0	0	0
	31/03-07/04	4	0	0	0
1985	02-10/04	1	3	0	0
	03-10/04	0	2	0	0
1986	24/03-04/04	15	5	4	2
	26/03-06/04	2	0	1	0
Wager Bay, Keewatin Region (Davidge 1980)					
1978	06-19/03	19 (unclassified)			5
1985	March	0			
Mansell Island, Keewatin Region (Kraft 1980)					
1978	10-14/03	15 (unclassified)			10

bears will have emerged from their dens even though the risk of storms concealing dens increases with the lateness of the survey.

Our results suggest that bears do not automatically return to den in the same vicinity each year. To date, surveys have been repeated only for Gateshead Island: in 1986 only four dens were found compared to 19 in 1977 and 15 in 1982. The knowledge of hunters, however, increases our sample size as hunters have identified areas and particular sites traditionally used by bears. On King William Island traditional denning sites were checked and found not to be in use in that particular year (1985). Likewise, dens were not found on Kull Island in 1986 although it is identified as a traditional denning area. Yet, the nearby unnamed peninsula, which is also a traditional denning area, was used in 1986.

The converse has also been found, namely concentrations of dens have been found in unexpected locations. In the Keewatin, Davidge (1980) located a concentration of dens along the south coast of Wager Bay in 1978 - an area where some 20 to 25 years previously, a hunter who had lived there for several years had only sighted one bear. Subsequent denning surveys in 1985 and 1986 have not documented the concentration of dens reported by Davidge (1980) (G. Stenhouse pers. comm.).

An understanding of the environmental factors that influence the use of areas for denning and the seasonal variation of those factors would lead to a more detailed understanding of the ecology of denning. That knowledge would be relevant to land use planning

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to schedule human activities away from areas with concentrations of denning bears.

Harington (1968) described several factors that could bring the bears into core areas for denning. Bears may congregate in the fall in areas where the winds, currents and tides move the drift ice to landfall. Harington (1968) cites the particular case of Pelly Bay, where the prevailing winds push heavy pack ice into Pelly Bay bringing with it bears from Lancaster Sound and Prince Regent Inlet. Schweinsburg et al.'s (1981) sample of tagged bears was too small to confirm whether or not bears were being brought from those areas. Schweinsburg et al. (1981) did comment, however, that open water during the summer between Prince Regent Inlet and the Gulf of Boothia may keep the bear populations of the Gulf of Boothia separate from those of Prince Regent Inlet.

The movement of multi-year ice brought down M'Clintock Channel by the currents and prevailing northerly winds probably explains the use of Gateshead Island, the Royal Geographical Society Islands and northern King William Island as traditional denning areas. Additionally, the seas surrounding those areas are relatively shallow which grounds the multi-year ice floes. Snow drifts build up among and between the pressure ridges and jumble of grounded floes becoming what Stirling et al. (1981) termed Type 1 ice. That type of ice is preferred for pupping by both ringed and bearded seal populations which are relatively abundant in the area. At least, in the eastern Beaufort Sea and Amundsen Gulf, Type 1 ice is selected by female bears with cubs possibly to avoid the larger and

potentially cannibalistic males which tend to select the floe edge and active ice (Stirling et al. 1981).

The role of ice movements in concentrating bears at summer retreats where they subsequently den may be more important than the type of terrain. First impressions of the terrain on eastern Victoria and its neighbouring islands are that the low beach ridges and eskers are not especially suitable for the accumulation of snowdrifts for denning. Other areas known for polar bear denning are typically more hilly or rugged areas such as Svalbard (Larsen 1985) or the islands of Pelly Bay. Possibly, the annual use of such areas as eastern Victoria Island east to King William Island is more variable as the terrain is less likely to accumulate suitable depths of snowdrifts.

Our results emphasize the importance of fall snow conditions in determining whether or not the bears den in a core denning area. For the previous three years (1984-86), the denning surveys on the islands off eastern Victoria Island and northern King William Island have found evidence of fall icing and shallow snow effecting the denning. It is not known where the bears den when conditions are unsuitable in those core areas. Harington (1968) also commented on the importance of snow depths and density to denning bears.

The prevailing fall winds tend to be northerly in our study area hence the snow drifts are deeper on slopes facing mostly to the south. Of the dens found during the surveys 1984-86, 31 were on slopes facing south, southeast or southwest. The remaining dens

(8) were on east facing slopes. Those results are similar to those described by Harington (1968), but exceptions do occur if the prevailing winds shift: the winds in fall 1981 were predominantly southerly and the 15 dens found on Gateshead Island in March 1982 were on northwesterly or northeasterly slopes (Williams and Jingfors 1983).

Harington's (1968) summary of his denning surveys and his comparisons with other observations of polar bear denning was the first detailed Canadian description of the denning behaviour. Consequently, the report is frequently cited and his terminology is used. Harington (1968:9) classified dens as "maternal" or "temporary": the former was the den dug by a pregnant female in the fall and then later used by her to give birth in and rear her cubs until they were old enough to venture outside. Temporary dens were defined as those occupied for 6 months to just a couple of days. We suggest that this is too wide a category to be useful especially in the context of land use activities.

There is always an element of arbitrariness in sub-dividing the duration of a behavioral activity. The thickness of icing in a den, however, could be used to separate dens occupied for most of the winter from dens occupied for a few days. Notwithstanding the arbitrary nature of such a division, we suggest that dens with less than 2-3 cm of floor icing be termed "temporary" and those with floor icing thicker than 2-3 cm be termed "winter" dens.

In his discussion of the factors influencing where bears den, Harington (1968) implied that some bears may not passively move

with the ice to reach their denning areas but may actively travel and navigate. If there is an element of learned behaviour in the return of bears to their denning areas, this would justify terming those core areas "traditional" as the outcome of a specific form of behaviour (sensu Wilson 1975).

The current main hunting areas for bears by hunters from Cambridge Bay, Gjoa Haven and Pelly Bay are on the sea ice in the vicinity of the traditional denning areas. The hunting of bears in their dens used to be a common practice by the hunters in some communities but is now no longer legal because of the difficulties of assuring whether a bear in a den is unaccompanied by cubs. In Pelly Bay for example, 77% of the 81 bears taken between 1952 and 1956 were taken from their dens and 35 of those were pregnant or females with young cubs (Van de Velde 1957). The shift away from the hunting of bears in their dens resulted in fewer females being killed: 67 of the 81 bears killed between 1952 and 1956 were females compared to 38 males and 36 females between 1968 and 1977 (Van de Velde 1957, Schweinsburg et al. 1981).

Polar bear denning surveys have been used to collect information on the productivity of the females. This is only practical if the surveys are repeated during the emergence period or if the observers remain in the denning area during that period (Larsen 1985). In the Kitikmeot Region, the collection of data on productivity has not been a priority because of the difficulty and time required to obtain adequate sample sizes.

The priority in the Kitikmeot Region has been to confirm the current use of denning areas known to hunters and to begin to unravel some of the factors that influence the annual use of those denning areas. This information will become of increasing value in the context of land use planning to assist in the locating and timing of human activities to minimize their effects on bears.

The annual variation in the use of denning areas has to be met by repeating the coverage of areas, choosing whenever possible, years when fall snow and wind conditions are dissimilar. Localities where concentrations of dens have been recorded should be monitored to detail the annual variations in the responses of the bears to the snow and ice conditions. The coverage of both coasts of the Boothia Peninsula requires further surveys which should concentrate on areas identified by hunters such as Thom Bay rather than further attempts to cover the whole coast in one survey.

The denning surveys have another, less tangible purpose that transcends the more pedestrian objectives of wildlife management. Many of the hunters who have contributed their knowledge to the denning surveys grew up on the land. Their knowledge is the accumulation of the observations from generations of hunters but the flow of the information is now disrupted by the abrupt imposition of a lifestyle centered in the settlements. Some of that knowledge has already been compiled and published (e.g., Van de Velde 1957, Freeman 1976). Our denning surveys are a contribution to the recording of the traditional knowledge of the hunters and its use in wildlife management.

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PERSONAL COMMUNICATIONS

S. Aaluk, Gjoa Haven, NWT.

A. Helmer, Renewable Resources Officer, Hay River, NWT.

L. Kamoolak, Gjoa Haven, NWT.

C. Niptayok, Pelly Bay, NWT.

G. Stenhouse, Ducks Unlimited, Yellowknife, NWT.

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APPENDIX A. Daily conditions during polar bear denning surveys, 1984-86.

Date	Temp. °C	Wind km/h	direct.	Visibility
1984 Admiralty Island and Collinson Peninsula				
31/04	-35	8	NE	overcast
01/04	-28	45	NE	poor
02/04	-32	8	N	clear
03/04	-30	10	NW	clear
04/04	-27	15	NW	ice fog
05/04	-30	0	-	clear
06/04	-23	5	SE	clear
1985 King William Island				
03/04	n/a	5	NW	clear
04/04	-26.5	5	SW	clear
05/04	-30	5	SW	clear
06/04	-31	5	NW	clear
07/04	-27	15	NW	ground drift
08/04	-38	10	NW	light ground drift
09/04	-33	20	NW	ground drift
10/04	-26	10	NW	clear
11/04	-28	20	NW	ground drifting
1985 Taylor and Admiralty Islands				
02/03	-27	10	E	clear
03/03	-30	10	E	clear
04/04	-33	5	E	clear
05/04	-33	5	E	clear
06/04	-30	10	N	clear
07/04	-32	10	N	clear
08/04	-38	5	N	clear
09/04	-30	25	NW	blowing snow
10/04	-33	18	NW	cloudy
1986 Harrison Islands				
26/03	-25	light	N	sunny, later cloudy
27/03	-21	strong	W	ground drift
28/03	-24	light	W	clear
29/03	-21	strong	NW	clear
30/03	-26	light	NW	clear
31/03	-25	calm	-	clear
01/04	-30	light	S	clear
02/04	-31	strong	S	ground drift
1986 Gateshead Island				
28/03	-30	light	NW	clear
29/03	-25	light	S	clear
30/03	-33	light	NW	clear
31/03	-32	light	NW	clear
01/04	-30	strong	S	ground drift
02/04	-31	strong	NW	blowing snow
03/04	-30	light	NW	clear

APPENDIX B. Summary of wildlife seen during polar bear denning surveys, Kitikmeot Region, 1984-86

1984 Collinson Peninsula

Muskoxen: one bull was seen on an island in Albert Edward Bay and two single bulls were seen on Collinson Peninsula. Five small herds of muskoxen (3,7,5,5 and 5) were also seen on the Peninsula and there were tracks all over the Peninsula. Two single dead bulls were found that had likely succumbed to malnutrition.
Caribou: the groundfast ice from the fall was probably the reason for the lower numbers of caribou (1,1 and 1) seen on Collinson Peninsula than usual. It was the first time that caribou had been seen on Admiralty Island - they were concentrated along the west coast (1,3,2,4,1 and 2).

1985 Admiralty and Taylor Island

Muskoxen: close to the DEW line site on Jenny Lind Island, a solitary cow had been seen for about a week before it died. The red-jelly appearance of femoral marrow was indicative of serous atrophy. Examination of the mandible in Cambridge Bay revealed that the incisors were peg-like, and the molariform teeth were irregular in height and vegetation was impacted between pm 1 and pm 2 (left). Only two herds of muskoxen were seen east of Cambridge Bay which was less than usual.
Caribou: Tommy P_____ told us that caribou moved from the mainland to Jenny Lind in early winter but returned before breakup; the caribou he had just taken had no visible fat reserves and had conspicuously worn hooves. Along the east coast of Admiralty Island there were ptarmigan tracks in all the caribou feeding craters and scapes. No caribou were seen.

1986 Harrison Islands

Caribou: one wolf-killed caribou was found and caribou were relatively frequently seen during the survey (1,5,3,1,6,3,5,2,8, 9,8,11,8 and 2).

1986 Gateshead Island

Muskoxen: during the return visit to Gateshead Island in July, muskox summer fecal pellets and shed wool were found.
Caribou: more caribou were seen than had been known during the last two to three decades. We saw 5,1,8,1 (cows and yearlings); 2 antlerless bulls and 1 antlered bull; 5,1,1,1,1,1,2,2,6,6,1,4,2,1, 1,4,5,4,4,2,3,5,1,3 and 1 mostly cows, yearlings and calves. In July, we counted 33 caribou which included 6 young calves and one

large bull with conspicuously pale grey velvet. Two sets of shed prime bull antlers were found and the scavenged carcass of a cow. She had permanent dentition with almost no wear and her femoral marrow was pink-white and firm. There were no fecal pellets in the vicinity and as the hooves were well worn, we surmised that the cow may have been too long crossing the sea ice from Prince of Wales Island and then fed on too much dry or cold forage.